Managing Fatigue in Long Duration Airlift Operations 1994

by

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Abstract

During September, 1994 the operational tempo for US Air Force C-5 transport crews was at a record high. Support flights were routinely sent to assist international efforts to bring peace to warring factions in Rwanda, Somalia and, in addition to their normal full time responsibilities, there were additional flights needed to reinstate the elected government in Haiti. I interviewed crews at Dover AFB to learn their perspectives of the sources and the extent of fatigue on these sustained missions. Many of these crews had participated in Operation Restore Hope II to Somalia which involved multiple 25 + hour flights from the US to Somalia before crew resting in Cairo. I learned the pace of C-5 operations has remained at record levels since the Gulf War. Important issues identified by the crews were cumulative sleep debt, circadian disruption and their impact on mission safety. I was able to accompany a crew throughout a planned 10 day support mission.

This report is based on my conversations with about 35 officers and enlisted transport crews. I was impressed with the similarity of the comments for the primary sources of frustration and fatigue in the conduct of C-5 missions. These are described more fully in the report but some deserve highlighting here. Many felt that once they did something demanding, like 20-hour plus missions or the then unprecedented three aerial refuelings needed in Somalia, it becomes expected, not the "one time only effort" they were told. There is a strong feeling that there are too many crews on BRAVO alerts, perhaps unnecessarily and BRAVO alerts were too long. Many were convinced that better collaboration with schedulers and the Wing would provide more realistic mission schedules.

Based on some objective data I collected, in-flight sleep on the C-5 may be less restful than previously thought. Analysis of the nutritional content available in the box meal were conducted and suggests good food is available but not often selected by crews. A decibel meter was used to sample sound frequencies at 6 locations on the C-5 and while louder than published in the C-5 operations manual, the Dash-1, is still within limits. Given that longer missions may be more frequent, noise limits may need to be reconsidered. It is my hope that this report will stimulate interest in a larger study of C-5 crew fatigue issues. Coping strategies for management of fatigue that are simple to follow and can be implemented in current operations are provided at the end of the report and were derived, in large part, from the experiences gained during this investigation.

Dr French has left the USAF and is now a fatigue consultant for shiftwork, jet lag and sustained duration operations.

INTRODUCTION

On 8 September 1994, I arrived at the 436th Airlift Wing at Dover AFB to discuss the issue of crew fatigue with members of the 3rd and 9th C-5 airlift squadrons. Our mission at the Sustained Operations Branch (CFTO) of the then Armstrong Laboratory at Brooks AFB is to evaluate the effects of sleep deprivation and circadian disruption in the lab and in operations and to develop counter-measures. We have experience in the past with monitoring the human issues associated with accelerated transport mission requirements like that, which occurred during the Gulf War (see References).

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VALIDATION RESEARCH

September, like many other months before it, saw the mission requirement rates for the C-5 at close to maximum due to the operational demands of Haiti, supplying medicine and food to Rwanda and in support of many other trouble spots around the world. My intent was to accompany as many missions as possible during the 3 weeks I had available for the study. I had hoped to experience the tempo and to hear first hand from many crews where they felt the sources of fatigue were in these missions. Unfortunately, I quickly learned that C-5 mission schedules are often sporadic and longer than expected. After a few mission opportunities were delayed, the first mission I accompanied turned out to be my only one due to a C-5 breakdown. Our plane was a good bet to last the entire mission because it was the newest C-5, that is, the last C-5 built. However, it developed an oil leak in one of the engines that forced us to wait for parts in Fujairah (United Arab Emirates). I shared the frustration of the crew in getting stuck at the far end of the supply line when operational demands prevented much of an effort at our rescue.

The data that I compiled then are based on conversations with approximately 35 officers and enlisted at Dover AFB. I was able to collect additional data on nutrition, quality of sleep and noise levels associated with a typical C-5 mission. I believe the data reported herein are representative and a good snapshot of the lifestyle and unique demands placed on C-5 crews.

I contacted the 436th Aerospace Medicine Squadron to advise them of my mission and to ask for their suggestions and possibly obtain any background information on crew fatigue. We discussed the primary sources of fatigue for aircrews; mission schedules, nutrition and billeting. Maintenance personnel were also suffering from fatigue. Poor crew rest discipline, including excessive alcohol consumption and poor nutrition are still a problem for some air and ground crews.

I spent the day talking to crews in the 9th and 3rd Airlift Squadrons learning about ALPHA, BRAVO alerts and crew rest time requirements. A second mission opportunity was delayed by a few days. A mission to numerous US naval installations in Europe and the Near East was the third opportunity and would leave on the 11th. I requested permission to accompany them, expecting to be back in about 10 days to take advantage of the original stage mission to Frankfurt that would be departing about when we were scheduled to return. Prior to my arrival in Dover, a former C-5 crewman told me that the average mission length was about 5 days. Most of the Dover crews I met felt this to be a short estimate as missions of late were averaging about 10 days. The lack of clear definition of mission times and BRAVO's point to a very large part of the frustration in the life of a transport crew. Not only is it difficult to know when a mission is to go, it is almost impossible to determine when to plan for their return. Lately, multiple crews are kept on BRAVO alert to ensure one mission will go. This is very disruptive to scheduling family events and sleep/wake cycles since BRAVO extends the normal 6-8 hours that crews are legal for alert to as long as 48 hours. Most crews felt that they always seemed to get alerted on BRAVO's just as they were getting to sleep. This means that the mission started after the crews had been awake for most of their day already. The crews I met at all levels were quite candid and seemed eager to describe fatigue related issues.

A senior pilot told me that the pace of current C-5 operations was still the same as during the Gulf war. It had not slowed down for his wing. He and many of the Dover crews flew the multiple, long duration missions (24+ hours) of Operation Restore Hope II to Somalia and followed that with humanitarian aid to Rwanda. He had many comments that address well the frustration and fatigue the crews feel. He felt the primary statistic was airplane utilization rate but should be crew utilization rate. He also felt that most of the crews are young and did not have enough rank or experience to challenge their assignment to extremely fatiguing missions involving inadequate crew rest intervals. He thought this could lead to dangerous levels of fatigue. There were complaints about too many quick turn missions (crew rest intervals of 16 hours) many of which were perceived as unnecessary. Another officer suggested that their situation was best described as "management by BRAVO". That officer complained that preventative maintenance had not been done on C-5s for about 5 years due to the pace of missions. He speculated that perhaps the C-5 would be less likely to 'break' if such maintenance was accomplished. He felt that mission cancellations and BRAVO alerts left very little certainty to their lives and this was disconcerting.

The crews I met with seemed to feel that they were being misused in many instances. As an example, another pilot made the point that during Restore Hope II they were asked to do triple and quadruple aerial refueling and do 30 hour missions "just this once". He felt that since they had demonstrated they could do it, these were now considered within normal operations. He also cited the disruption and stress of too many BRAVO alerts. There was almost universal agreement amongst the crews I spoke with, that too often the schedulers were not familiar with C-5 operations and the demands placed on them by long duration missions. It was recommended that C-5 crews should rotate as schedulers for a few weeks out of the year. They would learn mission planning from the perspective of the scheduler and the schedulers might learn more about the unique demands placed on transport crews. I learned there was an excess of co-pilots at Dover. Since they need lots of training, this means that instructor pilots must spend many hours teaching as well as flying their own missions.

Dover AFB had just completed Phoenix Pace when I arrived. This allows the crews time to recover and not fly for 2 weeks. Although crews are supposed to be given relief from missions, one crewman told me that there was too much ground activity, simulator training and other exercises, to permit adequate recovery. When Restore Hope II was initiated, Travis AFB was engaged in it's Phoenix Pace which required Dover to bear the brunt of those long missions. One of the schedulers at the 436th Wing showed me an interesting graph of utilization rate. Currently, the rate is about 40.5. The maximum rate is very close, 42. For comparison, a rate of about 28 is considered low and 35 is high. Three days after Phoenix Pace, the rate went from 4.0 to 40.0 and hovered around this "pain threshold" for many days.

Another senior officer told me that before the Gulf War, utilization rate was limited by airframes. Now that rate is limited by crew availability due to the drawdown from the war. However, schedulers still consider airframes in their utilization figures, as the other senior officer above had reported, not crews. Dover has 64 aircrews for 32 planes. He felt that surge type operations had become normal for today's operations. Everything had become urgent and that's why so many BRAVOs were scheduled. I discussed some alternatives with him and the best options seemed to be restoring routine maintenance on C-5s and reducing the time spent in BRAVO. For example, instead of 48 hours 'on the hook', the time might be reduced to 16 or 24 without too much of an impact.

The mission I could accompany arrived shortly thereafter. The crew seemed energetic and friendly. They seemed skeptical that we would make it back within 10 days so that I could pick up the Frankfurt stage mission. The crew were eager to point out things in the C-5 environment that were fatiguing. Sitting for long periods was an important fatigue factor but they realized that it came with the mission. The seats on the C-5 are very comfortable. The bunks are a great addition to the crew compartment. They can be sealed off and made dark and quiet. I learned the toilet fills quickly on the C-5 and since it would not get emptied normally until our return to Dover, they did not like to use the one in the flight deck. Instead, they go to the far end of the plane, the troop compartment, and use that one. The toilet in the flight deck area was in a large room and flushed well (maybe too well given the comment that it fills too quickly). The sink in the toilet room did not work. I'm told that the internal water supply for the C-5 has been turned off because of problems. Apparently, the water was foul tasting and discolored. Too often the water would freeze in the lines and create problems. The crew seemed content with the Igloo containers full of water. I wondered if that would be enough should we break down in countries where the local water was not safe.

One of the measures that we use in the field to determine length and quality of sleep is called an activity monitor or actigraph. These are wrist-watch sized devices that strap to the arm and count limb movements per minute for the duration of the battery life, about 2 weeks. I was very interested in using the activity monitor to compare sleep in the bunk with sleep in a bed during crew rest. I only had 3 activity monitors with me for the trip so I had to rotate them between crews to get an idea of sleep quality. Unfortunately, we had to wait in Fujairah a week for repair and crew rest became a non-issue. Also, data were lost due to battery failure on one of the actigraphs. From my records, I was able to go back and identify bunk time and sleep time on the record. No figures are available from the actigraphs for this manuscript since the data did not survive a computer crash in 1998. However, the results will be described albeit without reference to a figure. An advantage of the activity monitors is that it allows the sleep period counts to be evaluated; that is, to determine if the sleep period is restless compared to some baseline. Of course, inactivity in a pilots chair might also register scored

sleep inadvertently but not to the length of time that would be recognized as a sleep period. Since the activity monitors are very sensitive to motion, false sleep scores are not normal.

At Rota Spain, the Aircraft Commander (AC) went to sleep at about 2330 and awoke about 0700. At Sigonella Italy, the AC went to bed the next night at 0600 and slept until about 1230. The AC presents an interesting nap pattern. He will typically sleep for about 15 minutes and feel quite refreshed. Short naps, less than 40 minutes, are actually very sound lengths of time to nap without difficulty awakening (sleep inertia). I was careful to mark when he took a nap.

The engineer wore the monitor when we were awaiting repair parts for the airplane in Fujairah and I did not get a comparison sleep on the airplane. Since the times are Central Daylight Time, he was getting to bed about 1700 (CDT) or 0100 local time and awakening about 0100 (CDT) or 0900 local. A Loadmaster wore the actigraph when the AC did and also took a nap in-flight. Like the AC, his nap occurred around 2000 CDT. The activity associated with the C-5 bunk nap had the highest counts. The bunks on board the C-5 look very comfortable but the activity monitor suggests the crews are sleeping restlessly. This loadmaster stayed up upon landing in Rota until about 0500 (CDT) and then went to bed. He was remarkably consistent with his sleep time at Sigonella. Another crewman wore the activity monitor when the engineer did so no naps on board the aircraft were recorded. During the first crew rest in Fujairah (CR#1), an alarm clock in the engineer's room went off and kept him awake in bed trying to sleep for about an hour. He had also been drinking alcohol immediately prior to going to bed and I suspect this caused a typical alcohol induced insomnia on his rest. On the second night in crew rest (CR#2), he slept almost 12 hours, probably because of the poor sleep on CR#1. The activity monitor is a very useful way to objectively study the quantity and quality of sleep for crews.

The finding of restless sleep on the aircraft is important and needs to be supported by more data. If crews are not getting restorative sleep on the plane then techniques need to be explored that might help them to sleep more soundly. We have a simple handout describing how to maximize sleep that I have included in Appendix 1. It may be useful to expand on some of these principles in a two- three page guidance tailored to the transport crew.

The nutrition available to the crews is a very important aspect of the mission. Good food promotes good health, vitality and can influence morale. Accordingly, I paid careful attention to the meals the crew ate. I wrote down all the ingredients of the box meal and, with the help of the Armstrong Laboratory's research dietician, analyzed the contents for nutritional value. The crew said the choices were much better at Air Force bases but since this was a Navy support run we should expect limited food resources. Our food analysis however, favored the box meal from Sigonella in some ways over that from Frankfurt or Dover. Table 1 shows the Military Recommended Daily Allowance (MRDA) taken from AF Regulation 160-95 and the civilian Recommended Daily Allowance provided by the National Academy of Sciences (1989). Table 2 shows the summary for the 3 box meals as a percent of the MRDA recommendations in Table 1.

Table 1. Recommended Military and Cicilian Nutritional Components

	Military RDA	Civilian RDA
Kilocalories	3200 KC	2900 KC
Protein	100 g	63 g
Carbohydrates	440 g	446 g
Fat	124 g	96 g

Table II. Percent of MRDA provided by the box lunch at each location

	Kcalories	Protein	Carbohydrates	Fat
Dover	49%	51%	41%	64%
Signonella	37%	30%	36%	42%
Frankfurt	48%	78%	39%	51%

The box meal from Dover was quite good but slightly high in fat (64% of the MRDA) as shown in Table 2. The box meal is only supposed to supply 30% of the daily nutritional components and most of the meals supplied almost 50%.

Two of the crew seemed very interested in some of our work with the amino acid tyrosine. Since this essential dietary compound is the pre-cursor to catecholamines, a diet rich in tyrosine might enhance adrenergic activity. Colleagues at Army labs have shown an improved ability to withstand cold and altitude using tyrosine. We have not be able to show a similar result with sleep deprivation. Tryptophan is another dietary amino acid and is the pre-cursor to serotonin and ultimately, melatonin, the sleep promoting hormone. Therefore, foods rich in tryptophan may serve to promote sleep. We discussed the usefulness of meals 'ready for sleep' and meals 'ready for wakefulness' using these concepts and thought it a good idea.

Crew rest quarters at Rota were very comfortable and all the crew got single rooms. The crew however, managed to find lots of bad things to eat and drink. They were drinking lots of coffee and beer and most were eating a gastronomically difficult creation called a jumbo burger. We were given 24 hours in Rota which is not the best crew rest time. The AC and I discussed this issue and he felt the same way. Most of the time, it takes 2 hours to get the crew to billeting and to bed for a good 8 hours of sleep. Another 2 hours to get them back to the plane makes 12 hours a reasonable rest period. After that time, most people are ready for about 10 hours of activity before getting tired again. Scheduling a crew for 24 hours of crew rest gives them their 12 hour crew rest and their 10 hour activity phase but by the time they are tired enough to go to sleep, it is time to start the mission. A better amount of time would be either 16 hours or 36 hours of crew rest to avoid starting missions at the beginning of the normal sleep cycle. However, the crew seemed well-rested by their 24 hour rest period and ready for the next leg to Bahrain.

A few of the crew drank what I would consider to be more alcohol than would be conducive to a good sleep. Of course, the plane was broken and their frustration with getting it repaired might have been a factor. They were always careful to make the 12-hour alcohol free restriction but the crews need to know that alcohol can impair quality sleep and can produce insomnia. They should be advised to quit drinking a few hours before sleep as recommended in the suggestions in Appendix 1. I saw no one who seemed impaired the day following a night of drinking. However, the message about alcohol and sleep quality needs to be made even more forcefully, in my opinion.

The final measure I brought on board was a decibel meter. I was interested in finding the level of noise to which the crew were exposed. I used a Quest-Tech meter (510 Worthington St Oconomowoc, WI 53066 Phone 414 567-9157; calibrated on 14 July 1994). The meter came with a calibrator device that I was careful to use before every measurement since I am not skilled in collecting or interpreting sound. I took measures at each of 6 spots around the aircraft about 4 times and averaged the measures to reach a composite. I was careful to position the meter in the same spot each time and I only recorded when we had reached cruise altitude. I did get some additional decibel information during climb-out and during loading the aircraft. I also have data on altitude, ambient temperature and cabin pressure should the data need to be pursued. The AC showed me a table from his DASH-1 which concerned sound levels. In chapter 2A on page 97 were two tables that are relevant. One table showed the allowable exposure time to noise of varying magnitudes. I have reproduced it here in Table 3. The other showed similar measures taken around the C-5 which I have reproduced as Table 4. Figure 6 shows the decibel levels that I recorded from the 6 locations.

Table III. Partially Reproduced from DASH-1 to IC-5A-1

Decibel, dB	Required Ear Protection Allowable exposure (min) for 8 hour pd	
0 – 84	No Protection	
85 – 104	Headset/plugs	480 min
105 – 114	Headset/plugs	480 min
115 – 120	Headset/plugs	170 min
121 – 125	Headtset/plugs	71 min
126 – 130	Heatset/plugs	30 min

Table IV. Internal Noise on C-5

Flight Condition	Maximum location	Decibel
Ground/Take-off	Flight Sta	86
Normal Cruise	Flight Sta	84
Normal Cruise	Relief Crew	86
Normal Cruise	Courier	89
Normal Cruise	Troop	87
Normal Cruise	Cargo	94
Normal Cruise	Avionics	91

The meter I used was able to break the sound into component frequencies. There was also an all-pass feature that combined all frequencies. The legends in Figure 6 refer to the locations during cruise from which the measures were taken; FS=flight station, BN=bunk (door closed), RS=relief station, CG=cargo (mid-hold), TP=Troop and CO=courier. Inspection of Figure 6 shows that the all-pass levels I recorded are considerably higher than what was reported in Table 4. This could simply reflect a difference in which direction the meter was pointed during recording or some other methodological difference. It may be important to review the allowable exposure time in light of the longer missions the C-5 is flying (20+ hours) since that table is limited to 8 hours. It is interesting that the middle frequency (250 Hz) was associated with the highest dB levels. The higher frequencies showed the lowest dB values.

During climb-out, I recorded levels between 103 dB to 118 dB for about 5 minutes from the Relief Station. Only a few of the crew were wearing ear cushions in the relief stations. From the Flight station, the levels were between 100 and 108 dB on climb out, considerably higher than the levels reported in Table 4. Levels recorded during loading operations ranged between 70 and 90 dB in the mid-cargo bay area. Occasionally, a pallet related noise would get as high as 117 dB but infrequently. All the loadmasters had at least ear cushions in use during loading. I was interested in determining the level of noise attenuation by the ear cushions and the headset. However, I was unable to satisfactorily attach these protective devices to the decibel meter.

The crew complained that many who went to Mombassa had their plane re-assigned and we would likely be stuck there waiting for a new plane and mission. We communicated with another C-5 in-flight that had been in just that situation. They were long past their scheduled return time. Places like Mombassa or Rwanda easily became stages without being officially designated so.

Of all the crew, the engineer's task seemed to me to be the most fatiguing. They have to constantly monitor the panel for long shifts at all times. Research suggests that monitoring tasks are sensitive to long duration induced fatigue. I would guess the engineers would be the first to suffer microsleeps in-flight of all the crew. They did seem to regulate their own in-flight rests very well though. I did notice that most of the time, the crew slept in the chairs on the courier compartment or the relief station.

Our mission was supposed to take us 10 days. We ended up returning 15 days later. Due to the breakdown in Fujairah, we gave up our Navy mission to a functioning C-5 and picked up new missions as we returned. Our return mission took us to Frankfurt Germany, Keflavik Iceland and back to Dover. I was disappointed that there was no time to get on another mission since I had to return to Brooks AFB for 3 important meetings before the end of September. It is my hope that a broader study of the human problems associated with long endurance transport missions will be requested by AMC, particularly when the activity of transport crews is once again pushed beyond their usually high levels due to some national contingency.

CONCLUDING REMARKS

In our opinion, transport crews have the least predictable and often the longest missions in the Air Force flying community. Due to the extent of their transmeridian travels and the atypical sleep/wake patterns they must endure on missions, they likely suffer the most disruption of normal circadian cycles of all Air Force missions. The C-5 crews that I spoke with about fatigue felt that they could do the long missions if they had to. However, many perceived that limits were being escalated by their accomplishments and that gruelling missions were becoming the norm. Better collaboration with TACC by the Wing schedulers and pilots might promote less fatiguing mission schedules. The issue of fewer BRAVOs and shorter BRAVOs needs to be explored. In order to keep crews at peak readiness they need to have regularly scheduled sleep/ wake schedules as often as possible. BRAVO's disrupt these normal patterns and increase stress

The quality of food available to transport crews at their unusual hours of arrival and departure deserves more study. It would be useful to know what selections they have and what they are making throughout the missions. Since transport crews are relatively sedentary for long periods of time, the number and quality of calories consumed is very important and deserving of closer inspection. Crews should be better educated in what foods to bring with them and to select during a mission.

Some indications from the current study suggest that the quality of sleep in-flight and during crew rest could be improved. A careful study of in-flight naps is suggested to discover the timing and the conditions that make for the most restorative sleep.

An annual brief to transport crews about stress relaxation training, sleep hygiene, naps and circadian disruption among other topics, was proposed. This would additionally allow researchers to find out through discussion and surveys where the difficulties are from crews directly.

Finally, a careful study of the effects of mission demands on crews during a period when they are experiencing an increase in the number or duration of missions might provide important information for managing the human resource. Sleep/wake patterns, nutrition, exercise patterns and circadian disruption are among the fatigue related topics that should be further investigated in transport crews. It is likely that careful attention to fatigue management techniques (nutrition, sleep, schedules, exercise and others) like those proposed here might extend the ability of crews to make safer and longer missions. Coping strategies for managing fatigue that can be implemented in current operations were provided as part of the after-mission recommendations and are included in Appendix 1 of this report.

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Appendix 1

The Sleep/Wake Vigilance Strategies

FATIGUE MANAGEMENT TECHNIQUES FOR TRANSMERIDIAN TRAVEL AND SHIFT WORKERS

Your work may require you to be vigilant for long hours, especially during the early morning (0300-0700) circadian performance troughs. These are some techniques that may reduce your fatigue and improve your alertness. Before the extended duty period its very important to catch up on your existing sleep debt. Get as much uninterrupted sleep as you can for a few days before your mission.

Improve sleep. The quality of the sleep you get is vital to your performance when you are awake. You must do everything to increase the quality of your sleep.

1.) Make the bunks or beds you use as comfortable as possible. For example, use blankets for extra padding and take the time to protect your sleep environment from light, noise, vibration, temperature extremes wherever possible. If you get a chance to use a bunk on duty then you should because a chair is not nearly as conducive to a restful sleep. Otherwise, stretch out on the floor on padding. Get serious about your sleep. Take your shoes off if possible and loosen your clothing. Don't prop your head up too high when lying down because as you sleep your chin has a tendency to move towards your chest, preventing good respiration. Snoring and sleep disorders (insomnia at night, fatigue during day) can prevent a restful sleep and should receive medical attention. To help you doze off, practice muscle relaxation prior to sleep onset (ie. tense your hands and breathe deeply, tense your face and breathe deeply; continue this with all major muscle groups legs, stomach, shoulders, back, arms; imagine pleasant scenes).

2.) Schedule your sleep carefully. *Short naps* (no more than 30 minutes long) can be very helpful. *Bad naps*, naps between 1-2 hours long can be very difficult to awaken from since you will likely wake up in deep slow wave portion of sleep. *Long naps* however (about 3-4 hours long) are very restful. Neither short nor long naps should be too close to a long sleep opportunity (over 4 hour).

3.) Try very hard to get to bed at the same time each night and try to awaken at the same time. If a crew rest period starts in the morning (past 0600), compared to when you usually wake up (your body clock time), then you should get a long nap (3-4 hours) and get to bed as close to your usual time that night as possible. Don't allow yourself to sleep a full 8 hours at this unusual time or you will have trouble getting to bed later. In-flight or on duty share sleep availability with fellow crew equitably. Excessive alcohol disrupts normal sleep. It can cause insomnia and it can ruin a restorative sleep. Do not drink to excess and stop drinking about 2-3 hours before you go to bed. Try drinking water in the interim to hydrate yourself. Also, avoid caffeine 3-4 hours before naps or sleep.

Enhance vigilance. If you are required to remain awake and vigilant for long periods of time and especially during the circadian performance trough, you should take advantage of fitness, nutrition and the environment. Prior to long duty days or night work, you would do well to ensure that you have adequate sleep (7-9 hours) each night at least 2 nights prior.

1.) Periodically throughout a long duty day, try brief 10-15 minute exercise intervals to combat fatigue (stretch, aerobics, isometrics in seat). Stand and move about if possible and do so at regular intervals. Pushups, situps and other exercises in place can be invigorating. Exercise regularly. It helps to stay vigilant if you're in shape.

2. Use refrigerators and ovens on the aircraft or duty rooms and make an effort to eat healthier choices of food. Have your large meal for lunch rather than dinner. Generally, high protein foods upon awakening and complex carbohydrates before retiring. Stay hydrated. Caffeine and alcohol can dehydrate you. Brushing your teeth and washing your face, attending to your appearance periodically can refresh you.

3. Use as much light as available to illuminate crew environment (planning room, cafeteria, billeting, flight deck, office, break areas) especially at night to promote vigilance. Bright light at night can reduce fatigue. If you can't work in brightly lighted areas, take frequent 2 minute stretch breaks in light. Daylight (and fresh air) are best for these breaks.